

## CLAIMS

- 1     1.     A method of performing echo suppression in a telecommunications system, in-  
2     cluding the steps of:
  - 3           (A)     calculating the energy represented in each PCM sample of both the voice  
4     information received from a user's telephone equipment, and transmitted from to the tele-  
5     phone equipment;
  - 6           (B)     aggregating the energy data for samples over a 5-msec period to form a  
7     frame of an aggregate energy value;
  - 8           (C)     populating a matrix with these aggregate energy values;
  - 9           (D)     solving the normal equations for the matrix;
  - 10          (E)     examining the results to determine a peak aggregate result which will in-  
11                  dicate the time delay and gain of the echo path; and
  - 12          (F)     evaluating incoming samples on a periodic basis against the correspond-  
13     ing output energy result obtained at the determined time delay, and if the input speech  
14     energy is determined to be less than a historical output energy scaled by the determined  
15     gain, then the signal is classified as echo and is suppressed from the input speech signal.
- 1     2.     The method of performing echo suppression as defined in claim 1 including the  
2     further step of  
3           smoothing the results of the normal equations by applying a moving average to  
4     correlations and energies over each frame across the time dimension.
- 1     3.     The method of performing echo suppression as defined in claim 1 including the  
2     further step of  
3           determining said time delay by measuring the time elapsed between the beginning  
4     of measurements and the reaching of the peak aggregate result.
- 1     4.     The method of performing echo suppression as defined in claim 1 including the  
2     further step of

3           employing a voice activity detector to verify that voice information is on the line  
4   and if so, then performing steps A through F and suppressing any echo that is determined  
5   to exist.

1   5.     An apparatus for performing echo suppression techniques in a telecommunica-  
2   tions system, comprising:

3           (A)    a receiver that receives PCM samples of voice information from a user  
4   coupled with the system;

5           (B)    an energy accumulator coupled to said receiver that calculates the energy  
6   of the input speech signals and aggregates these energies over a predetermined time pe-  
7   riod;

8           (C)    digital signal processing circuitry coupled with said receiver and said en-  
9   ergy accumulator that is programmed to perform the following:

10                   (i)    populate a matrix with energy aggregate values for 5 msec  
11                   frames;

12                   (ii)   solve or approximate the solution to normal equations for  
13                   said matrix;

14                   (iii)   produce results and evaluate said results to find a peak ag-  
15                   gregate value and a time lag;

16           (D)    checking each incoming speech sample against said peak aggregate value  
17   and time lag to determine whether said speech samples contain echo; and

18           (E)    means for suppressing echo that is determined to exist in an incoming  
19   speech sample.

1   6.     The apparatus for performing echo suppression techniques as defined in claim 5  
2   further comprising

3           voice activity detector coupled with said receiver that determines whether in-  
4   coming samples contain speech, and if so, said echo suppression techniques are per-  
5   formed.